

HIGH DENSITY POLYETHYLENE LINING SPECIFICATION  
MATERIALS, INSTALLATION, AND TESTING  
TENNECO GOLDSTRIKE PROJECT

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HIGH DENSITY POLYETHYLENE LINING  
MATERIAL AND INSTALLATION SPECIFICATIONS

1.0 GENERAL

- 1.1 This specification defines the requirements for High Density Polyethylene (HDPE) flexible membrane liner (FML) materials, installation and quality control.
- 1.2 The HDPE installation Contractor, "Contractor" shall provide manufacturer's certificates of compliance with the material specification of Section 2.0 for the FML sheeting to be provided for the job. These certificates shall be provided to the Owner's Engineer, "Engineer" prior to commencement of liner installation.
- 1.3 Contractor shall provide all materials, equipment and labor to effectively install the FML according to the requirements of Section 3.0 and the manufacturer's recommendations. A copy of the manufacturer's installation procedures shall be provided to the Engineer who will resolve any differences between these specifications and the manufacturer's recommendations prior to installation.
- 1.4 Contractor shall provide all testing apparatus and labor to perform the field quality control testing described in Section 4.0.
- 1.5 The following publications of the latest issue are part of this specification.

American Society for Testing and Materials (ASTM)

Federal Test Method Standards (FTMS)

National Sanitation Foundation (NSF)

2.0 LINING MATERIAL

- 2.1 The HDPE liner material shall be a high quality product containing approximately 97+% polymer and 2 - 3% carbon black with anti-oxidants and heat stabilizers. The formulation shall be resistant to ultra violet sunlight and high pH Sodium Cyanide solutions. The resin used for welding shall be the same as the resin used for manufacture of the sheet.



- 2.2 The HDPE material used to fabricate the FML shall consist of new, first-quality product meeting the minimum, raw materials requirements of the National Sanitation Foundation (NSF) Standard No.54. (1985).
- 2.3 The material as delivered shall have been approved by the manufacturer's fabrication quality control program and shall not include any second material with holes, blisters, unmixed raw materials, irregular thickness, or any sign of defects. Contractor shall inspect all delivered FML material at the job site for indications of damage. Engineer will conduct spot checks of the FML material and the packing slips to verify that it is the right type, thickness, and quality specified. Any faulty or defective FML shall be marked by the Contractor and Engineer and shall be repaired, if possible, or set aside.
- 2.4 The FML material provided shall be 60 mil, HDPE with manufacturer's certifications that it meets or exceeds the following:

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>VALUE</u>	<u>UNITS</u>
Density	ASTM D-1505	0.945	g/cm <sup>3</sup>
Melt Flow Rate	ASTM D-1238 Condition E	0.2 <sup>+</sup> -0.4	g/10 min.
Ave. Molecular Weight	ASTM D-2857	1.5 x 10 <sup>-4</sup>	
Strength	ASTM D-638		
Tensile Stress			
at Break		3,800	psi
at Yield		2,800	psi
Elongation			
at Break		500	percent
at Yield		10	percent
Elasticity	ASTM D-882	80,000	lb/sq.in.
Initial Tear Resistance	ASTM D-1004 Die C	30	lbs.
Impact Resistance Notched	ASTM D-256 Method B	no break	ft.lb/inch of notch
Puncture Resistance	FTMS 101-C Method 2065	108	lbs.



Coefficient of Linear Expansion	ASTM D-696	$1.2 \times 10^{-4}$	per C°
Hydrostatic Resistance	ASTM D-571 Method A, Proc. 1	315	psi
Water Absorption Change	ASTM D-570	< 0.1	% weight
Env. Stress Crack Resistance	ASTM D-1693 Condition C Notch Depth A	1,000	hours

### 3.0 INSTALLATION

- 3.1 All FML rolls shall be carefully handled to avoid damage through use of slings or other manufacturer approved methods. All FML in storage shall be placed on wood planks or directly on firm ground free of sharp rocks, sticks and debris.
- 3.2 Contractor shall be responsible for assuring a FML subgrade that is firm, smooth and free of wet areas, ruts, depressions, holes, abrupt grade changes, broken rocks, sticks, sharp objects, vegetation, and debris. Final preparation of the subgrade surface shall consist of raking followed by compaction with a smooth, steel-wheeled roller. Areas not accessible to the roller shall be compacted with mechanical or hand tampers. If the subgrade becomes saturated or eroded by storm runoff, the Contractor shall cease installation of liner on those areas until the subgrade material is dry enough to support the FML installation equipment. Any storm damage to the subgrade surface shall be repaired prior to resuming FML installation. Contractor shall certify that the subgrade surface on which the FML is to be installed is within the manufacturer's warrantee conditions before commencing installation of the FML.
- 3.3 The clay subgrade for the FML must meet the density and moisture requirements set out in the earthwork specification and should be protected from drying that may cause cracking. The moisture conditions of the subgrade are best maintained if the FML Contractor installs the HDPE sheeting as soon as possible following final grading and compaction of the subgrade. If this is not possible, and in the opinion of the Engineer the subgrade has excessively dried, the surface of the subgrade shall be reconditioned with an application of water and recompacted with the smooth,



steel-wheeled roller.

- 3.4 Contractor shall provide a site supervisor who has previously installed a minimum of 1,000,000 square feet of similar HDPE liner. Contractor's installation personnel shall have at least minimum training in the purpose of proper FML handling and placement, and knowledge of safety procedures.
- 3.5 Only those sheets of FML that can reasonably be handled by the seaming crew during the course of the work day are to be placed in that day. All sheets shall be laid in place and overlapped the proper amount for lap seams as they are unrolled. During unrolling of the FML sheets, Contractor shall carry out visual inspection of the sheet surface. Sheets shall be placed in the correct locations with a minimum of sliding over the subgrade. Any faulty areas shall be marked and repaired by Contractor. Sandbags shall be immediately placed every 5 to 6 feet on the edges of any sheets that are unrolled and subject to displacement by wind. Contractor shall be responsible for repairing or replacing any FML that is damaged by wind prior to completion of the installation. FML shall not be placed or seamed when, in the judgement of the Contractor or Engineer, weather conditions will preclude seaming within the manufacturer's warranty conditions.
- 3.6 Contractor shall be responsible for controlling runoff from the lined area prior to completion in a manner that will not damage the liner or the liner subgrade.
- 3.7 Contractor shall prepare the areas to be seamed according to the manufacturer's requirements. The area to be welded shall be dry, clean, and prepared for the fusion welding process with a method approved by the manufacturer. The resulting welds shall have material and strength properties at least equivalent to the unwelded sheet. All seams shall typically be lap joints with a minimum 4-inch overlap pointing down slope. Contractor shall define in detail the welding method to be used, the weather limitations on welding, and demonstrate that it meets the manufacturer's requirements.
- 3.8 At least two, 3-foot long sample welds shall be made by each welder during each shift with one sample weld made at the beginning of each shift. A sample weld shall also be made whenever a welding machine has been turned off and on. Contractor shall mark each test weld with the date, ambient temperature at the time of welding,



welding machine number, and welder's name. These sample welds shall be tested according to the specifications of Section 4.0. All of the sample welds shall be retained at least until the end of the FML installation project.

- 3.9 The welding equipment shall at all times be in good repair and capable of maintaining uniform fusion conditions for all welds.
- 3.10 All holes, bad seams, and welded folds shall be overlapped with a patch made from the same material as the rest of the FML, and fusion welded to surrounding liner that meets the specifications.
- 3.11 Design penetrations through the FML shall be field welded with a hand welder. All pipe penetrations shall be HDPE pipe or sleeved with HDPE pipe. An HDPE apron shall be welded to the pipe or pipe sleeve and shall be welded to the base FML sheet.

#### 4.0 FIELD SEAM TESTING/QUALITY CONTROL

- 4.1 Random samples shall be cut from each test weld by the Contractor and tested for shear and peel according to Standard Number 54 (NSF, 1985) or ASTM D-4437. The test weld samples shall have strength characteristics equal to the parent FML material.
- 4.2 Contractor shall be visually inspect all welds for proper squeeze out, width, melt, folds, wrinkles and overlap. All apparently defective welds shall be marked for further testing or repair.
- 4.3 Contractor shall test all seam footage at the time of welding, following curing to achieve maximum strength, with a non-destructive weld test to detect any unbonded edges or seams. The test method may consist of vacuum box with 4 to 8 inches of mercury vacuum, ultrasonic pulse echo, ultrasonic impedance, electric spark, pressurized dual seam, or other manufacturer approved method. All defects shall be marked on the FML for repair.
- 4.4 Destructive samples shall be obtained by cutting out sections of installed seams from which coupon samples for peel and shear testing may be cut. The frequency of destructive sampling shall be directed by the Engineer but shall not be less than one sample per every 500 linear feet of field seam. Approximately 10 percent of the destructive samples shall be submitted



to an independent laboratory for concurrent, confirmation testing of shear (ASTM D-638) and peel (ASTM D-413).

- 4.5 For field seams that fail non-destructive or destructive tests, the seam may either be reconstructed between the failed and any previously passed seam location or the Contractor may go on either side of the failed seam, take another sample, test it and if it passes, reconstruct the seam between the two locations. In all cases, the repaired seams shall be bounded by on either side by passed test locations. All repaired seams must be retested as per Sections 4.3 and 4.4.